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ABSTRACT

This paper presents an overview of biocybernetic communication research, which deals with the information impact of films, television, photographic pictures, paintings, exhibitions, texts, and verbal stimuli on human beings. The first section describes the biocybernetic basics of biometric research, and clarifies terms used in the field. The information chain, the conditions of transmission, receiver, information production and perception, information cascade, perceptual time and space, perceptual rhythm and symbols are discussed. The second section presents the history and future of biocybernetic research. Current research includes eye movement studies and electrophysical experiments. In the future, new biometric laboratories may be added to universities and hospitals, and new instruments and methods will be developed. Section three describes instrumentation and methodology in biocybernetic communication research. The kinds of energy changes measured by biometric means are thermal changes (changes in body temperature), electrical changes (EEG), and chemical changes (chemospectrographic analysis). Laboratories measuring such energy changes need the following kinds of instrumentation: (1) sensory scanning instruments, (2) cortical (brain function) scanning instruments, (3) control feedback instruments, and (4) recording devices. Four methodologies are outlined in detail. An appendix depicts visual information input, biometric amplifiers, and recordings. An eight-page bibliography is included. (LMO)

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Biocybernetic Approach to the Communication Process

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World Communication Association Convention
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INTRODUCTION

Biocybernetic communication research deals with the information impact of a film or television show, photographic picture, painting, exhibition, display or any literary or functional texts or verbal stimuli on human beings, both individuals as well as on groups (mass audience).

Biocybernetic communication research consists of a series of specific tests - sondages performed by the psychophysiological instrumentation on live persons who receive the media information input.

I see the information processing perception and storages within the human world as an energetic process with catalytic characteristics.

Therefore, what we measure in biometric research are the energetic changes in the human body due to the information impact from films, television, radio programs, or generally due to the perception of our informational environment.

A number of terms should be clarified first, before we go into the specifics of testing methodologies, instrumentation or various approaches taken in the past decades by various researchers.

The disciplines or fields, which substantially help or clarify the subject are; information and systems theories, cybernetics, neurology, neurophysiology and neuropsychology.

BIOCYBERNETIC BASICS OF BIOMETRIC RESEARCH

Under the term "information" I understand in a broader sense, energetic change with catalytic character. In the sense, information is a basic component of every television program, film, theater, play and radio piece. The previous definition is connecting information in media with information processes going on in and between plants, minerals and animals.

Under the term "design" I mean the organization of this process toward determined goals and impacts.

In our world, between human beings, information processes have a specific structure, which I call an information chain. In a simple scheme, it has three parts:

Information Source	**Transmission Conditions**	**Receiver and his response**
(TV program, film, play, news, etc.)	**(Readers room cinema-theater TV set, exhibition)**	**(People, viewers, TV watchers, etc.)**

If you change any part of the information chain, the information itself is changed. For a long time it was beleived that an information source contained all the information itself and nothing could change it. Now we know that an information source carries only part of the information cabalble of starting the catalytic process. Sometimes an accidental structure (stone, cloud, view in a street, etc.) could be an information source. Information sources capable of starting the information chain in most cases of human perception are called logistic or artistic structures.

Transmission conditions (room, cinema, TV, any perceptual environment etc.) were beleived to be only a passive pipe, through which a message was delivered to the destination, to the people. This exists when the information is delivered immediately. The situation could be reversed if the transmission is occuring for a longer period of time or on a large distance or quantity of TV programs beamed to home for weeks or years.

The repeated transmission conditions are stimulating a perceptual stereotype, specific for each transmission medium; (the medium itself may carry important and influential, but never pronounced messages).

Receiver (viewers, audience of a theater, play or concert, readers) were beleived to be the consumers of an information source. This is far from the truth. An information source is never physically consumed, it is perceived. This perception could lead, but not necessarily so, to the comparative information processing and retention in the brain. A quantity of information, its structure or succession is not the same, as in an information source, and can be, and in most cases is, diametrically different. By retention, only part of the information quantity is released from the information source, is factually stored, in the human memory.

By the processing and storing of information in (viewer's) brain, other processes are happening, which incoming information is starting as a catalyser. In this sense we are witnessing the information impact. This may provoke the receiver's response. This response could be a latent one (on a meta-level) or a pronounced, behaved one. It could also start another information chain.

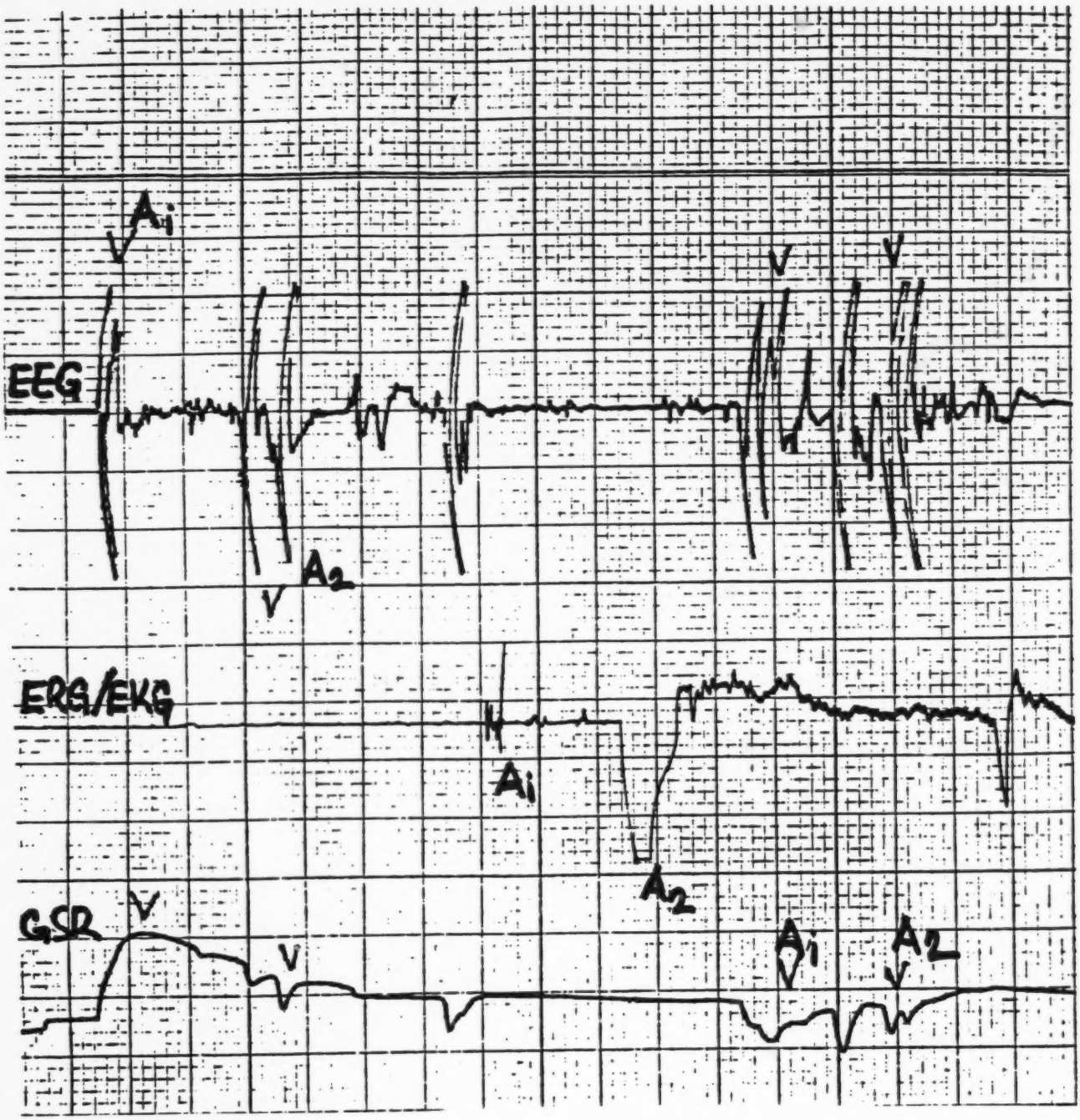
An information chain is existing in a certain time and space.

The time of information production and information perception has a different axis.

Production time is very well know in media, (time necessary to produce, organize or structure certain segments or complicated information), as well as transmission time (the airing time in television, screening time for film). The least known is the perceptual time. It is commonly beleived, that the time of transmission or performance should be identical with the time of information perception. Even if it seems to be a common understanding in human communication modes, it is not.

Figure 1. is an example of a multichannel biometric recording, showing the perceptual time differences from the information input, till the meta-level response.

Figure 1. Multichannel Biotelemetric Recording



As you can see in Figure 1., the time differences are in the milli second range. In the past, these time segments had little or no meaning. But, with the development of large successive complexes of information, (film, plays, television programs), those perceptual delays are causing the overlap of information.

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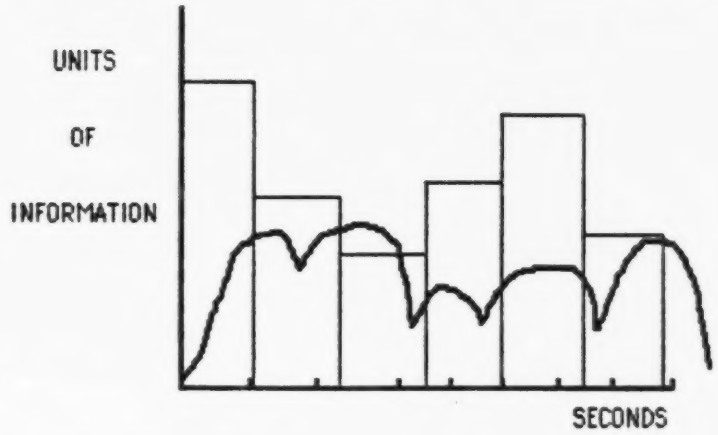

Figure 2. Overlaps in the information Cascade

When one information quantum is processed, the others could not be processed in the same range or intensities. Even if the short term memory could delay certain quanta, the constantly incoming information is more and more overlapped. (see Figure 2. above)

The overlaps in information processing are typical for an information complex, called and information cascade. There are two different kinds of information cascades: one, when the perceiver (people) have their own freedom to perceive one piece, part of the information one after another at their own pace, (exhibition gallery, book, newspaper). This I call a horizontal, linear cascade.

Usually, there is great freedom for the perceiver, not only toward the individual perception time, but also toward the freely chosen succession of pieces. The second information cascade is typified by fixed programmed succession and time for perceiveing the pieces of information (film, television program. theater, play, concert) which I call a vertical, structural cascade.

The high overlaps are typical for vertical information cascades. Each piece of information (scene, shot, sequence) is perceived in a period of time called, perceptual time, which varies with different groups of people, in different cities, countries, year or century.

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There is an important geneologic and historical phenomena in perceptual time speeds. During the space of the human life, a person perceives everything with different speeds and in different manners. Also, during the centuries the perceptual time has changed. People in 1470, 1880, 1920 and in 1973 were perceiving their information worlds at different speeds. I would say that in contemporary time, the speed of perception, especially on the American continent, is the fastest one ever known. This of course does not mean that all the perceived information is fully processed and stored. But in a certain sense, nowadays we are living more than one perceptual life generation span. Compared to the fourteenth or seventeenth century, the contemporary man is living five or seven perceptual life spans during his/her own life. This may be one factor in the complex called the generation gap, or a reason for the complaints that a son cannot understand his father's conception of life and ideas, if the father is perceptually his great-grandfather.

If we know the perceiver's way of information processing and storing, the complex of all his habits and approaches toward information, we can call this the perceptual spectrum of (mass media audience).

The perceptual spectrum of the audience is varying with both <u>time</u> and <u>space</u>. The human environment, culture and history (tradition) is influencing highly the way people are perceiving the world. The similar environment, culture, tradition could group the individual perseptual stereotypes into a common way of perceiving. This process is basic for the development of mankind. In tribal societies, man had fixed first information stereotypes (ecologic stereotypes of ways for hunting, tool production, etc.); <u>developed</u> highly fixed stereotypes (language, alaphabets) and coming toward the highest development in his environment, culture and traditions <u>diversities</u> of those lengthy and costly developed codes.

In this sense, we are now dealing in mass media with <u>highly diversified audiences.</u> No longer is it true that there is an "average viewer" or "average profile" of a television or film audience. Very small groups of audiences are differing in their habits of perception, and only in the very high abstract, (not necessarily the same) they are joined together and understood as common signs. We are now dealing with a "<u>multilayered perceiver</u>", each has a layer of their mind with different specifications of interests, and preferences in time, (no longer the prevailing "priime-time", and specification of place, town, and country).

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The diversification of the transmission centers (cable television, satellite) is speeding up this process. The same has happened in exhibitions, museums and galleries. In those fields designers have developed a specific way of how to attract this "multi-layered visitor", to the information sources, (multi-media exhibitions, multi-programmed galleries and museums).

When the receiver of the information has the multi-layered characteristics, it becomes difficult or impossible to transfer one information source from one place or group of receiver to another. The same information source is understood quite differently in different places or for different groups of people.

The logistic understanding (what a story or theme or artwork is about) becomes less meaningful for people with a different perceptual stereotype and spectrum. The most misleading things are happening when some people tear out the information source (film, TV program, painting) or its parts and put it in a separate, isolated place, then start to judge the values of it. Finally, this is coming toward the plain formative judgements, of no value for the majority of the receivers, a mistake of most film and television and juried festivals. Each medium has its geneology of perception. In the beginning, with the first appearance of a new medium, the external formal parts are the carriers of the major influence; when becoming used to the medium, the semantic part of the information is becoming understood, and when those semantic parts are becoming too easily understood, after a long exposure to the medium, (film, television) the formal parts are once more closing the eclipse with a high importance for the receiver.

The same cycle is happening, when the time base is introduced in any medium by the execution of the theme. When the theme is presented too slow, the small, sometimes unimportant formal details become the carriers of the messages; when presented in a comfortable speed for perception, the semantic characteristics are becoming the most important; when it is presented too fast (faster then the average perceptual speed), the content of the message could become unimportant, leaving only the external formal parts as carriers of the message.

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Knowing the role of time and space in the information chain, it becomes visible, that the creator of the information source could not alone outline all the characteristics of the source, not knowing the perceptual spectrum of the audience. This does not mean that an artist must be on the tail of the audience, fullfilling all their wishes. But respect for the information chain assures the success of his projected art work. (This plays similar role for business or political information chains structures).

Inside the information cascade, the structure of time is becoming important. When placing an important message into one time unit, it should be assured that in that time most of the audience is perceiving actively and are putting this information on a high place of importance.

There are several basic facts influencing the structure of time in any information chain:

1. <u>The basic (metabolic) perceptual rhythm:</u>

The human perceptual system has period of high operational sensitivity and periods, where, due to the metabolic changes, the functions of the sensors or channels are slightly subdued. This is ahppening (with great deviations due to age, physical activities or imposed neural activities) approximately twice per minute. Chidren could have three or more periods, older people could have one or less then one period per minute.

2. <u>The imposed perceptual rhythm:</u>

The previously mentioned basic rhythm could be modulated due to the input of information from an information source or the environment. The artist can hasten or slowdown the natural rhythm to a great extent. To do this, a certain time is always elapsing (of several minutes). To accomodate a person on a certain unusual perceptual rhythm, it takes, for a single sensoric channel, sometimes 10-15 minutes (overtures in operas), for a multiple channel delivery, 2-5 minutes. To change the imposed rhythm it takes a much shorter time, but always this change goes over the one or more periods of the natural perceptual rhythm.

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3. The stress (oscillated) perceptual rhythm:

When using catalysts, creating stress waves in the human brain of the perceivers (or "emotional" impact), it could happen that the perceptual rhythm is irregular, with returning irregularities during short periods. This situation could create a "bouncing" effect, even if external stimuli is not present, (we could add in the receivers mind, a certain dialogue, actor, situation, even if they are not present on the screen).

The perceptual rhythm is factually changing the information source parts (without anything changing in the film, painting, photography, television program). This process is causing much of the so called "subliminal effects" in tightly programmed media pieces, (TV advertisements).

Below in figure 3. is an example of "idea amplification" and "idea depression" due to the perceptual rhythm.

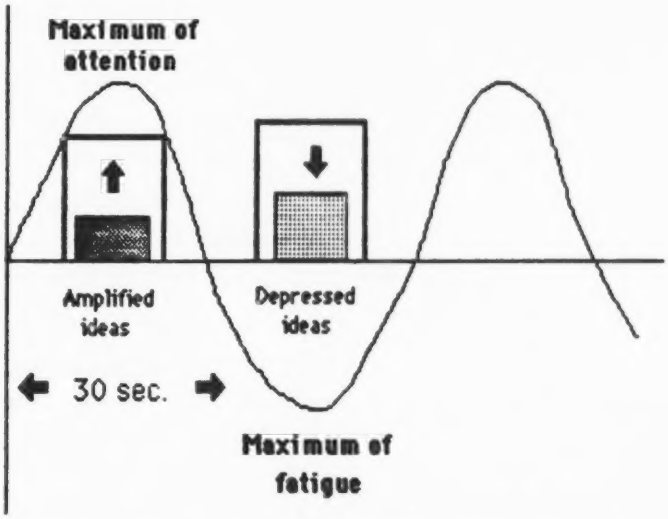

Figure 3. Perceptual Rhythm Graph.

In this graph, if we place any information (dialogue, action) in the positive part of the rhythm, (upper curve), the peak of attention, the information impact of this sequence, (shot, scene), will be increased at the audience side. If we place the same information in the negative part of the curve, (rest period, or peak of fatigue), the information impact will be decreased, no matter how important this information is within the overall structure of the piece.

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When the informational environment is supplying the person with many informations in a short time, people start to join them together. This joint information is dialectically becoming a new quantity, having a different content, sometimes in no connection with those previous contents of the individual parts. Large joints of information are called information patterns, (those may evoke qualitatively different responses form the same sources).

Example: You are driving on a highway at a low speed, through a suburb of a town - you can distinguish every house. At high speed you perceive the same as a housing entity. You are now unable to perceive detail features. One of those houses has a tower, you consider ugly. When driven by at a high speed, you may retain only the memory of this ugly tower, skimming over the nice features of the houses without any retention. Similarly, this could happen in a television program, where certain shots have a very positive value, but the audience skims over and retains only negative details because of their position in a successive speed of images. Thus is developed the pattern of a country, of a car, people, and many others. This pattern stays for a certain time in the human memory, the specific parts of the patterns decay, leaving only the indespensible features of it. This simplified pattern is called a perceptual stereotype. For evoking such a stereotype, a minimal amount of distinguishing signs is necessary. (Example: in an oval stone we could distinguish a human face, in a tree during a fog, a human posture, a black dot on a highway as an automobile).

Information patterns and percepttual stereotypes are shaping the taste and fashions of the media audience. Both are an inclination of large segments of the audience to distinguish the shapes or situations easily and fast with their memory or sensory perception.

Information patterns and perceptual stereotypes, in a certain way are close to a natural process, in which the human eye is simplifying any picture falling onto the retina and after this certain simplification, input to the neocortex of the brain.

When many information patterns exist in daily life, the less the individual content of its parts is perceived or stored in the memory. When several perceptual generations are living in the same time, as in our time period, this process could be viewed as a shallowing of previous ideas, contents or themes.

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Also, it influences any theme presented by the media, which is permitting easy information pattern transfer (television) and builds a certain resistance, when presented in media with a low information pattern transfer, (abstract painting). On the other hand, information patterns are allowing a faster transfer of ideas and meanings.

When information patterns are used for a long time and are successful in communication between people, it becomes a symbol. There is nothing mysterious about any symbol in present or past use. High practicality, easy use, easy fixation in the human memory are the basic ingredients of any symbol. There is a particular way of fixations in visual symbols which is basic in following the physiological characteristics of the eye and its extension through the visual nerve into the brain. Audio symbols are highly fixed in speech and in certain tunes and music.

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THE HISTORY AND FUTURE OF BIOCYBERNETIC RESEARCH

Although connections between neural and psychical processes are mentioned faintly by Paracelsus, the first scientific experiments in this area began in the 19th century.

The Austrian physiologist, Johann Evangelist Purkinje (after whom Purkinje cells in the human brain are named), had made a series of experiments during the period between 1834-1852 in Vienna and Breslau, aimed at a connection between the human brain and psychical processes of human behaviour. He constructed a series of stroboscopes, called "kinesiscopes" for primitive tachistoscopical observation of images and the response to the series of test pictures (made on Daguerrotypes) matched with data regarding blood pressure (blushing), body temperature and the speed of mneomotoric movements of the face and body. Results of this research were presented to the Austrian Academy of science in 1852 with a major classification of human behavioural types (choleric, sanquinic, melancholic....). This classification was used until the end of the 19th century in psychiatry.

H. Helmholz observed inthe years 1853-1861, the response of the human eye to the psychical events (fear, surprise, joy) in great detail, and tried to connect the saccadic movements of the eye to the person's psychical nature. He devised a primitive opthalmoscope, working on the principle of the corneal reflection of a gas flame, registering the deviations on a horizontally moving photographic plate.

Jean Ettienne Marey, the French physiologist, performed numerous experiments duirng the years 1874-1886 with cardiographic registrations in his physiologic laboratory. He observed a definate coincidence between the psychical processes and the change of heart rates, by working with mechanical and pneumatical cardiographic instruments.

Adalbert Londe constructed, in 1888 a special chronophotographic camera for the registration of multiple physiological responses.

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The first electrophysiological experiments were attempted in various countries during the first two decades of the 20th century. The first distinct EEG registration known is from G. Leurier's Laboratory in Paris in the year 1913. At that time, the electrical response from the brain's cortex was (incorrectly) beleived to be a direct measure of the "rate of thinking" or "intelligence. Neither the instrumentation, nor the electrodes were capable of registering more than a slight deviation of the ohmeter needle. The first registration of EEG responses on paper appeared in 1924, the first EMG registered response in 1928 and GSR (or lie detector registration) in 1931.

There were various theories of what caused the fluctuation of electromagnetic fields within the human body, ranging from the theory of "fields", "neuroelectric mechanisms", to sheer postulates of "energy emanators' and "ESP electrical power potentials".

In 1939, the Czech neurophysiologist, J. Laufberger, postulated the first scientifically documented theory of "neuron circuitry". Under his theory, the electrical potential and its changes are relevant to the level of inner energy of the neuron cell and the fluctuation of such energetic potential is exponent of the "work" that the neuron does. He also postulated the interconnection of the neurons, via axons, into the "circuitry", and associated the spike of the EEG recording with passing energy quanta through the measured point. This theory was revolutionary when very little was known about the chemical changes inside the neuron cells, as well as regarding the functions of the cell membranes.

In 1946, Norbert Weiner advanced the system theory under the new name, "cybernetics". Part of his work had an influence on the thinking about the human brain as an information processing system. As an indirect result of this thinking, the Swedish neurophysiologist, S. Malcolm, developed the first information scheme of the brain in 1951 and postulated the inter-connections between the symptomatic and peripheral neural systems. His work gave solid ground for further study of EKG, GSR and EMG responses to the psychical processes.

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Between the years 1952-1958, the Belgian researcher, Ing. Sallesi-Lavergne, built the first known biometric labratory for the measurement of physiological responses to films in Bruxelles. He employed a combination of psychological and physiological measurements. The indirect observation and conditioning (via infrared photography) was combined with GSR and ESR response registration.

During the same time, two other biometric laboratories were built in Czechoslovakia and Russia. At Purkinje Physiological Institute in Prague a five channel biometric labratory was in operation aimed at the measurement of responses from the psychical impact of exhibitions, museums, galleries and various propogandistic materials. The results of this endeavour later led to the development of unconventional exhibition styles and performances know as, polyecran, Laterna Magica or kinoatomat.

In the Soviet Union, Prof. Yarbus started experimentation with physiological measurements of audiences in 1952, and perfected the electroretinographic instrumentation and methodology to a great extent. The major part of the work was carried out in Moscow during the '50's and '60's, but the laboratory ceased its activity after 1967.

In Japan, Prof. Yagi started his experimentation with multichannel biometry in the early '60's and developed a very sophistocated biometric laboratory at Nihon University in Tokyo. The Japanese contributed greatly to the miniaturization of biometric scanning equipment and to the indirect increase of electrode sensitivity (amplifiers).

A major breakthrough was presented in 1965 with the invention of the distant electrode scanner (Harrison, England) and a very sensitive barium lythium electrode, although practical use was hampered by a high level of noise present within the scanned signal.

In the USA, the long tradition of electrophysiological response research dating from 1921 (McCall, Greene, Laskin) was first enhanced during the '30's when experiments of a biometric nature were taking place in Bloomington, Indiana (Gilbert, Morse, and Dunn), in Baltimore (Bailey, Miller), and in Rochester (Minn). The second major advance occured here during the '50's (Haber, Stark, Atkinson, Hubel, Campbell, Thiel) with specialized recording of various biometric channels. During the '60's, the first spectral analysis of EEG was performed by Zeitlin, Gevins and J. P. Spire and similar work was carried out in the analysis of auditory and visual stimuli by Stacy, Lear, Griffin and Oliver.

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In the past ten years, we can see a number of approaches or experiments done in the USA and Canada with close pertinence to the biometric research of films, radio and television programs. The most publicly know biometric channel used is that of visual information input, or so-called "eye movement studies". Here, the number of experiments are numerous, with at least four major groups of experimentors, several manufacturers of instrumentation and an unknown number of applications.

1. The basic tachistoscopic research is carried out in Bloomington, Indiana, with the adjoined largest US manufacturer of instrumentation (Lafayette).

2. MIT, with its Advanced Visual Studies Group, carries out experimentation with a comnination of electro-oculography and electroretinography with the adjoint manufacturer of instrumentation (Biometric/Narco Medical Group).

3. A Los Angeles group is working at UCLA under Prof. H. Suber on the cognitive aspects of visual stimuli, with the support of a US dealer of Japanese instrumentation, (National Camera Corp.).

4. In Montreal, Canada, Technolab Industries have researched intensively into the aspect of visual sensory tracking.

Much less is known of researchers in the EMG and GSR responses:

1. Kinsman, Robinson and Gatchel researched GSR and EKG responses to speech.

2. J.E. Fletcher at the University of Georgia was very active in the field of GSR measurements, applied to the cortical information processing.

3. R. Wells applied GSR aand BSR measurements to the reactions of a cognitive nature.

4. J.R. Kennedy experimented in Toronto with GSR measurements applied to films.

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The least clear is the situation in the application of EEG measurement, as here the signal carries an enormous quanta of noise.

1. Walter and Peterson (at J. Hopkins Hospital, Baltimore) performed the first attempts of EEG spectral analysis, using a short piece of film as stimuli in 1969.

2. Blackman, Cooley, Lewis and Welch performed the first Fournier transformations of EEG recording, using as a stimuli a series of photographs and recorded pieces of music in 1975.

3. Remond, Smith, Andrews and Sampson attempted the first chemospectrographic analysis with the use of sonic detectors, using a TV commercial as a stimuli in 1977.

4. At Stanford Research Institute's neurophysiologic laboratory, experiments are underway with the use of acoustic optical chemospectrographical scanning (holographic system), where regular TV programs are used as stimuli.

5. In Montreal, at Concordia Universsity, a multi-channel biometric laboratory tests the information impact of films and television programs since 1974.

If we look at current and future uses of biometry for film and television, the following streams can be foreseen:

1. Within a few years, more laboratories such as ASI in Los Angeles, will be established using biometric instrumentation.

2. Within an academic field, we may encounter a dozen or more universities active in biometry (Indiana, UCLA, Columbia, Stanford, MIT) leading in research instrumentation and laboratory set ups.

3. In Clinical biometry, we can foreseen the establishment of several biocybernetic laboratories within the major hospitals (two are already in operation at J. Hopkins, Baltimore and Pallisades, New York; another two are in construction - The Mayo Clinic in Rochester and one in Ann Arbor, Mich.).

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4. In instrumentation, we can see a certain decline in development within the USA territory asnd a rise in Japan and Europe (Germany, Sweden).

5. A major thrust in methodology goes from the single channel recording to multi-channel recording, then to spectrographic and Fournier transformation analysis, to the computer diagnosis.

During the next decade, the emphasis will definately be on the multi-plexing of EEG recordings, with sonic and optical/sonic sensing of the brain, and with distant remote sensing electrodes in the very near future. In the meantime, various telemetric set-ups (such as Datel) will be improving the range, the efficiency of the signal transfers and recording over distances. This will allow more flexibility, transportability of the testing set-ups, and convenience in research applications in various environments.

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INSTRUMENTATION AND METHODOLOGY IN BIOCYBERNETIC COMMUNICATION RESEARCH

This section will discuss the basic instrumentation (equipment), and the methodology applied in Biocybernetic Communication Research, presently in use in our laboratory at Concordia University in Montreal.

There are three basic kinds of energy changes that we are able to measure via biometric means:

1. **Thermal changes (changes in body temperature)**
2. **Electrical changes (EEG)**
3. **Chemical changes (chemospectrographic analysis)**

It is important to note that any of these changes can be interrelated at any moment over a particular time axis. The interval between these changes is called the *biometric* potential. When looking at graphical records of the tests, the various peaks and lows in the record are these registered potentials. What they correspond to is the energetic changes, processes in the brain's neuron circuits, that are activated by the input of information, processing or storage, but also from many other possible processes not in direct connection to the biometric recordings.

The overall process is far from simple and thus cannot be interpreted as such. Large spikes or changes in potentials on the recordings, may not correspond directly and in the same extent as the impact of the information and vice-versa. As a result, very sophisticated diagnostic techniques have been developed, ranging from quantitative, comparative analysis, to high tech. analog-digital computerized analysis of biometric data.

Information interception, perception, processing and storage of information from media pieces, such as film and television programs, is not a static or only quantitative process. It is very much the opposite, a dynamic, systematic and on-going process, a form of matrix, which follows the actual time of the program airing (screening) and is reflected in the receiver's mind and memory for a further period, (hours, days, weeks).

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A basic biometric laboratory would be able to test a number of stimulus sources; ranging from photographs, slides, posters, films, television segments, literary text, scripts, etc., to actual news or documentary materials.

To carry out such research activities, measuring the information impact on human subjects, a biometric lab would consist of the following instrumentation:

1. Sensory scanning instruments such as an electro-oculograph combined with an electro-retinograph, (visual input) where the response of the direction of eye movement is combined with the retinal response, an audimeter with an audiospectrograph (sound input).

2. Cortical (brain function) scanning instruments such as an EEG (electro-encephalograph), if possible in combination with an electro-chemospectrograph.

3. Control feedback instruments, an EKG, (electrocardiograph), and GSR, (Galvanic Skin Response) monitoring channels. EKG measures the changes in osmotic blood pressure, confirming the stress-wave process in the cortex, usually associated with the reflection of emotional impact. GSR is a slower channel, but a control that gives a vivid indication of any major attitudinal, content reaction to the stimuli.

4. Recording devices for data storage such as a datagrpgh, x-y plotter, digital to analog converters, and a micro computer (Apple, etc.).

This set-up would form a basic biometric lab. Many instrumentation variations are possible, ranging into sophistocated scanning devices, distant electrodes, telemetric data transfer equipment, and larger computer processing facilities. All the above would be limited to available funding or access through joint cooperation of investigators on the particular research task undertaken.

In practice, there is often a theoretical division between research into an information source, the transmission conditions, or the receiver response. Also there can be certain technological differences or the application of different methodologies when studying visual, audio, or audio-visual information sources. However, there is always a significant difference among the test subjects that are used in the research study.

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In practical application, most often all the previous considerations are present when complex testing is undertaken. Thus it requires that certain rules be followed in testing.

Basic Rules in Biometric Research:

1. Every person receiving information input from a media piece is a different, specific individual and thus can have a very specific, personal biometric response.

2. Transmission conditions, of the medium, can change the form and the content of the same information input.

3. The results of the tests, by all exact research standards possible, must be of a synthetic, cumulative aspect, taking into account the parts of the information which may have little or no relationship with the measured input.

Based on the above presumtions, it is necessary to follow some strict methodological procedures during the biometric testing session.

Methodology I

1. Before beginning any testing, a precise pre-test must be made. This is a key for later diagnosis of the test results. It is cued to each individual test subject.

2. Any changes that are observable in the person's physical behaviour must be recorded on the test, because any physical change in the subject will cause a corresponding change in the instrumentation. It must be adjusted and recorded by the researcher during the testing session.

3. The final tests should be verified by a series of questions related to the stimuli, and recorded directly on the test strip. If there is a discrepency or conflict between them, the test should be repeated.

4. All the test results should be read comparatively, one channel in relation to the others overall, and at all times in cue with the time scale log of the information input; time frame of the stimulus.

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Methodology II

1. **Test subjects: Choice and evaluation.**

a). The potential test subject must agree voluntarily to participate in the testing procedures and sign a written release form at least one week before the testing session begins.

b). A short interview and medical check-up gathers preliminary information on the subjects that are under consideration. Unsuitable cases are excluded, perceptual problems, physical disabilities, etc. The information is kept in confidential files.

c). The purpose, methodology, and instrumentaion to be used must be thoroughly explained to each of the subjects, in consideration of the subject's potential fear or apprehension of the laboratory environment. Any subject that has such an objection to the procedures, etc. outlined, is free to exclude him/herself from the testing session.

2. **Pretesting of the subjects:** Preparation for biometric testing involves extensive pretesting for control considerations. The following steps are included.

a). Input pretest: Each of the input channels used must have the following pretest for: range intensity, range contrats and range field. The ranges of audio and visual perception of the subjects should be aligned with the ranges of the recording instrumentation. The zero point of the instrument must be matched to the state of no-input of information.

b). Processing pretest: In this case the EEG and EKG channels must be aligned and adjusted with the basic responses of the subjects, (open-closed eyes for the visual channel and sound-no-sound for the audio channel. For the GSR and/or EMG channel pretests, verbal cues are given to achieve the desired or non-desired state and these are aligned with the range of the instrumentation.

The two pretests above must be done with several repetitions in a short time span. In each, the reading should be indetical for at least two to three recordings. Prestesting should last no longer that 5 minutes to avoid subject fatigue.

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The same consideration must be given in pretesting the biometric equipment that will be used for the testing.

3. **Equipment pretests.**

a). Technical pretest: Each piece of biometric equipment to be used must be initially wired, adjusted and aligned to the test subject. All the equipment is then cross checked for sensitivity, ranges, and attenuation of the channels and also checked to the test subject. During this process no actual stimuli is used, only a blank card or field where the stimulus materials will appear, is used as a guage for the alignment of the equipment.

b). Programmed pretest: In this case, a short sample of material similar to the test material, but not part of it, is used as a pretest run to determine if the instrumentation system is in correct working order. The results of this test are compared with the other technical pretests and if any adjustments to the instrumentation, electrodes etc. are necessary, they are made at this time. The first major test run should be made no longer than 30 seconds to a minute after the final technical pretest.

All the above mentioned pretesting is part of the general testing procedures and preparations. As such, it must be done before the actual tests are run on the stimulus materials. It is intended to serve as a reference and deliniate the sensory fields, reaction times, processing abilities of the test subjects, their scanning abilities and processing patterns. These pretests are critical in the later diagnosis and interpretation of the actual test results, and must be performed in the same manner for all test subjects used and with strict adherence to the steps outlined above.

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Methodology III

Biometric tests:

1. **General Readibility Test:** This is the basic multi-channel biometric test, run in a manner where the test subject perceives the stimulus material in a free style, at his or her own pace. No changes or adjustments are made from the pretest period. Following this test, a short diagnosis, evaluation, of the result is done and then the Decision/Selection test is performed. The aim of this test is to scan the general input of information, its processing and storage. The important part of the results are the envelope curves, as well as high amplitude areas and any dense peaked areas that may appear.

2. **Decision/Selection Test:** This test is limited to only the parts of the stimulus material where definate reactions were found during the general readability test. These pieces are extracted and tested specifically, in order to separate the cululative effect of the information cascade that exists in the stimulus material, from the impact of the *information domains* (an area, segment of high information impact). This test is performed using a high speed recording, of only the parts of the general readability test where there were either high excitation sections or any areas of dense, high amplitude showing. The results of this test should show the structure and characteristics of the *information domain* segments of the stimulus. Also it may show any direct or cululative impact that exists within the information cascade used as test material.

3. **Basic Media Tests; (colour, movement, shapes):** Each one of these tests may consist of a comparative reading of the sensory input channel, against the specific characteristics of the test stimulus material. (visual segment, pictures, texts, etc.). Any changes within these basic media are made evident, when the specific part of the information plotted is changed or if the input parameters are changed. The resulting recording is always compared back to the general readability test for interpretation and diagnosis.

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4. **General Processing Test:** For this particular test, multi-channel biometric instrumentation is used, with the EEG (electroencephalograph) channel in basic operation for the processing of input. The other sensory tracking channel, eg. EKG, is used as a supplementary one for time log tracking. The EEG channel is the one used for the diagnosis of this test. It looks for the general processing patterns of the information input, through diagnosis of specific EEG patterns, always related back to the time log of the sensory input and the time scale of the media piece itself.

5. **Stress Wave Test:** This test allows us to look for the development of "stress waves" during the processing of the information received by the test subject. The instrumentation used consists of the sensory tracking equipment (input, visual/audio), the EEG channel, and in direct time synchronization the EKG channel. A stress wave becomes visible immediately on the EKG channel, usually within a 1-2 second range from the input. People will vary in the intensity of the recording received on the registration equipment. The recordings produced could diminish within a few seconds or they could continue for longer periods of time and have a rhythmical pattern, a bounce like wave structure, in relation to the time log.

6. **Reaction Test:** In this particular test there are three possible kinds of reactions that are registered: (a). general reaction, a positive-negative registration with the zero in the center; (b). a negative, resistance test; and (c). a positive, action test. The general reaction test uses the GSR channel as the leading indicator, with the sensory tracking and the EEG as the complimentary channels. The negative, resistance, test, uses a combination of the GSR and the EKG channels. Finally the positive, action, test uses the GSR channel as the leading indicator combined with a multiplexed (alternated recording) of the EEG and EKG inter-relationships and a precise time log verification. All these reaction tests take their diagnostic cues from the test subject's pre-test, which will reveal that person's actual reaction structure or functioning. With many different subjects used in the testing, the GSR peaks are sometimes initiated by different stimuli. Therefore in all cases of diagnosis of these tests, the EEG recording is read, before any conclusions are drawn from the results.

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Methodology IV

Other testing considerations.

The are four other basic steps in the biometric test process which must be considered in the overall scheme of the testing procedure.

1. **First Test Session:** The first tests with a subject should be done within as short a time span as possible following from the pre-test stage. The elapsed time should not be longer than approximately two minutes, whenever possible, then the test should be run using multi channel recording equipment. This test run will also take into account the time span for the exhibition or screening of the test materials.

2. **An Oral Check-up:** Immediately after the first test run is complete, a short verbal check-up should be made with the subject in regard to the registration of their reactions. The questions, in this case, should be cued to the portions of the test recording where the registrations went out of alignment for some reason, or where a significant reaction was obtained. In each case, a cross check to the stimulus time log will be helpful in the correlation of the specific event or part of the information source creating the impact. The reason for such an oral check-up is to eliminate any possible confusion over the registration results due to side effects, such as motoric or metabolic reactions etc., which are not related to the test stimulus. These side effects can cause drastic jumps in the registrations and if not cross-checked, could later be mis-interpreted by the researcher.

3. **Second Test Session:** This stage should begin no longer than approximately 10 minutes after the previous two. The pretests and the test itself are repeated. In this second test run, the instrumentation should be checked for alignment to a state as close as possible to the first test session. Any differences, such as adjustments to settings of amplifiers, electrodes, etc., must be marked on the pretest strip itself. In this test session, special attention is usually paid to any areas of high reactions, the information domains, and if this is the case, a high speed of chart registration or recording of the data should be chosen.

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4. **The Marking Stage:** After the completion of the test session, the researcher should show the test results to the subject, explain what took place, and generally interview them briefly, to check on the test results. The purpose of this session is to detect any accidental results, such as instrumentation or equipment operation mistakes. This stage also contains the marking of the recordings for high intensity areas, by cueing the envelope curves on the recorded channels. It is also appropriate to cross align any channel interactions with the time log, for use in later diagnosis and interpretation. Any other information that the researcher feels should be noted, must be written down directly on the test results and kept in the subjects confidential file for later reference.

The interpretation of the biometric registrations, whether they are graphical recordings or digital information displayed in a visual form, is far from an easy task. This information is a mechanical, electrical, quantification of a very dynamic, human, biological process. Anyone involved in this area of research must understand that the individual spikes, changes in the biometric potentials, may have very little meaning in the overall diagnostic procedure. The parts that are of more importance and interest to us are the "envelope curves" of the activities registered and the patterns of these activities. The isolated high amplitude spikes are not likely to be significant, unless they have occured periodically in the recordings or with some observable patterns emerging.

Patterns should be looked for in the initial pretesting of the subjects. Any small irregularities, or delays in the reaction times to the stimuli, or even asymetric registrations of symetric stimulus materials, can later determine the patterns that emerge from the actual testing that is performed on the individual subject.

Overall, biometric research methodology is a useful tool for insight into the human information processing of audio-visual media, if the guidelines and procedures discussed here are taken into account. The stages, practices and rules outlined, have been applied successfully in many research projects in the past, enabling researchers from varied disciplines to explore topics in all facets of the communication process.

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APPENDIX A

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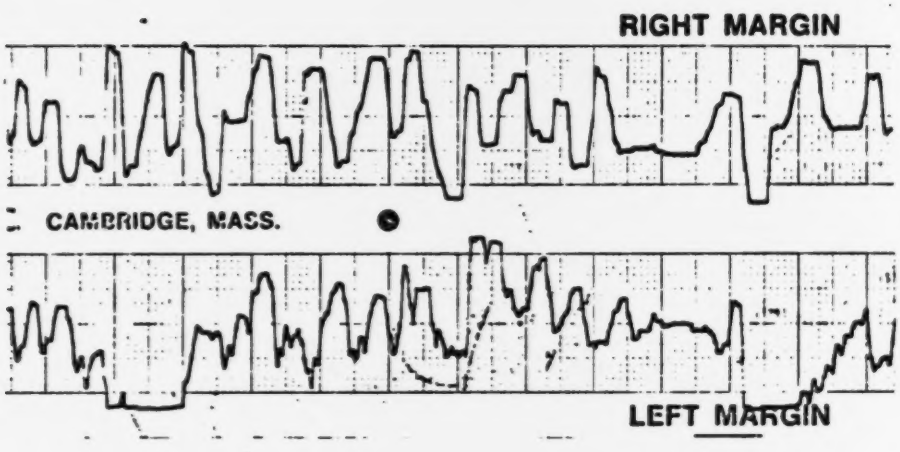
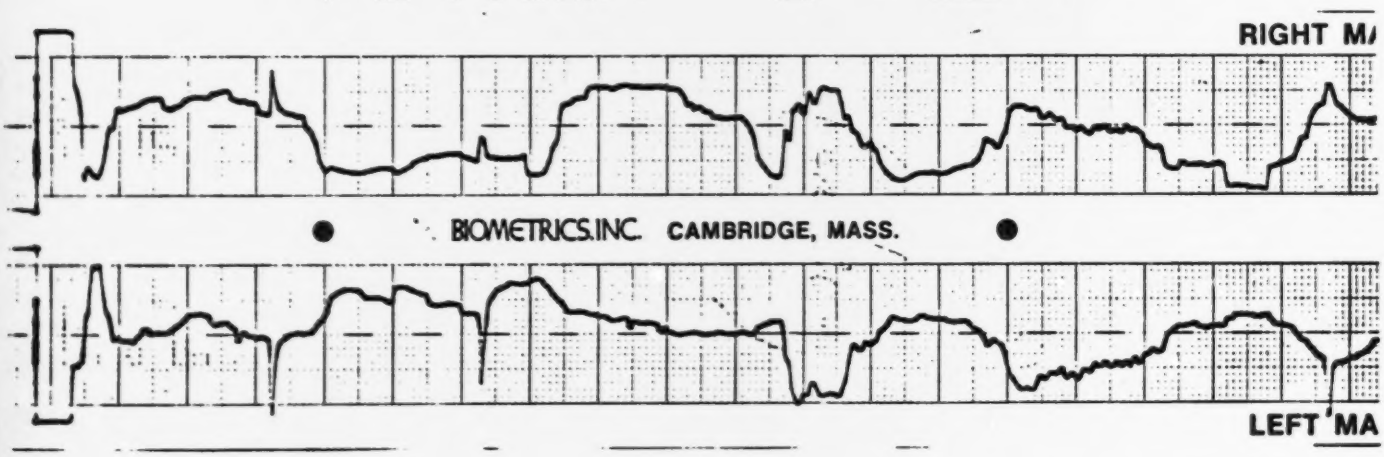
Examples of visual information input:
Electro-oculograph/Electro-retinograph





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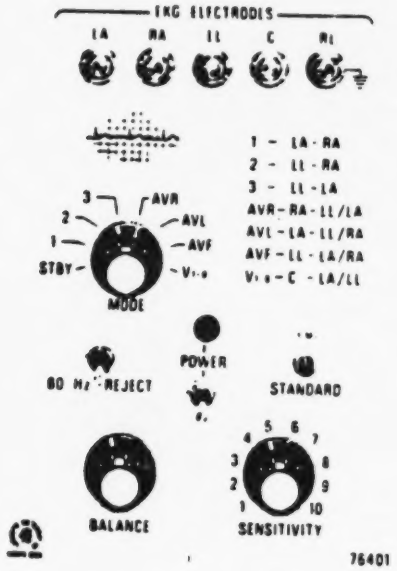
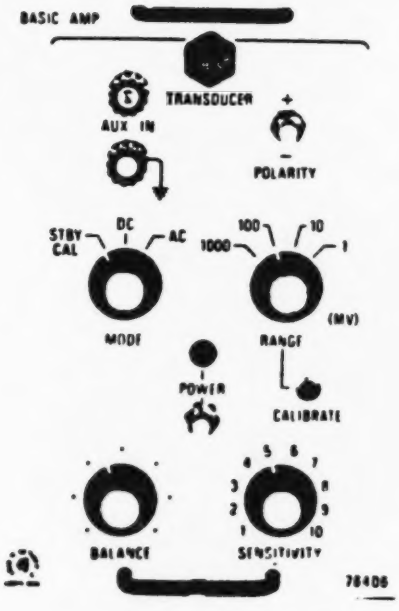
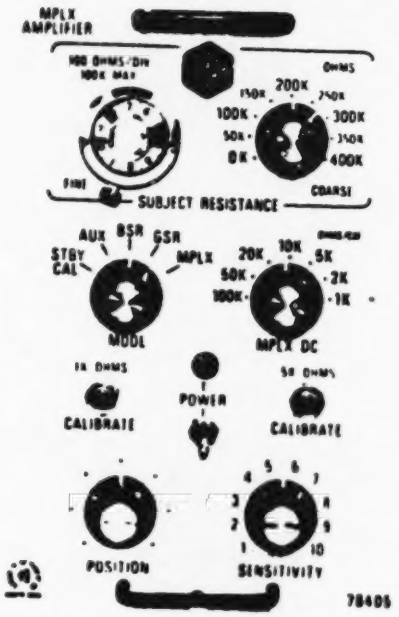
Examples of biometric amplifiers and electrode preamplifiers







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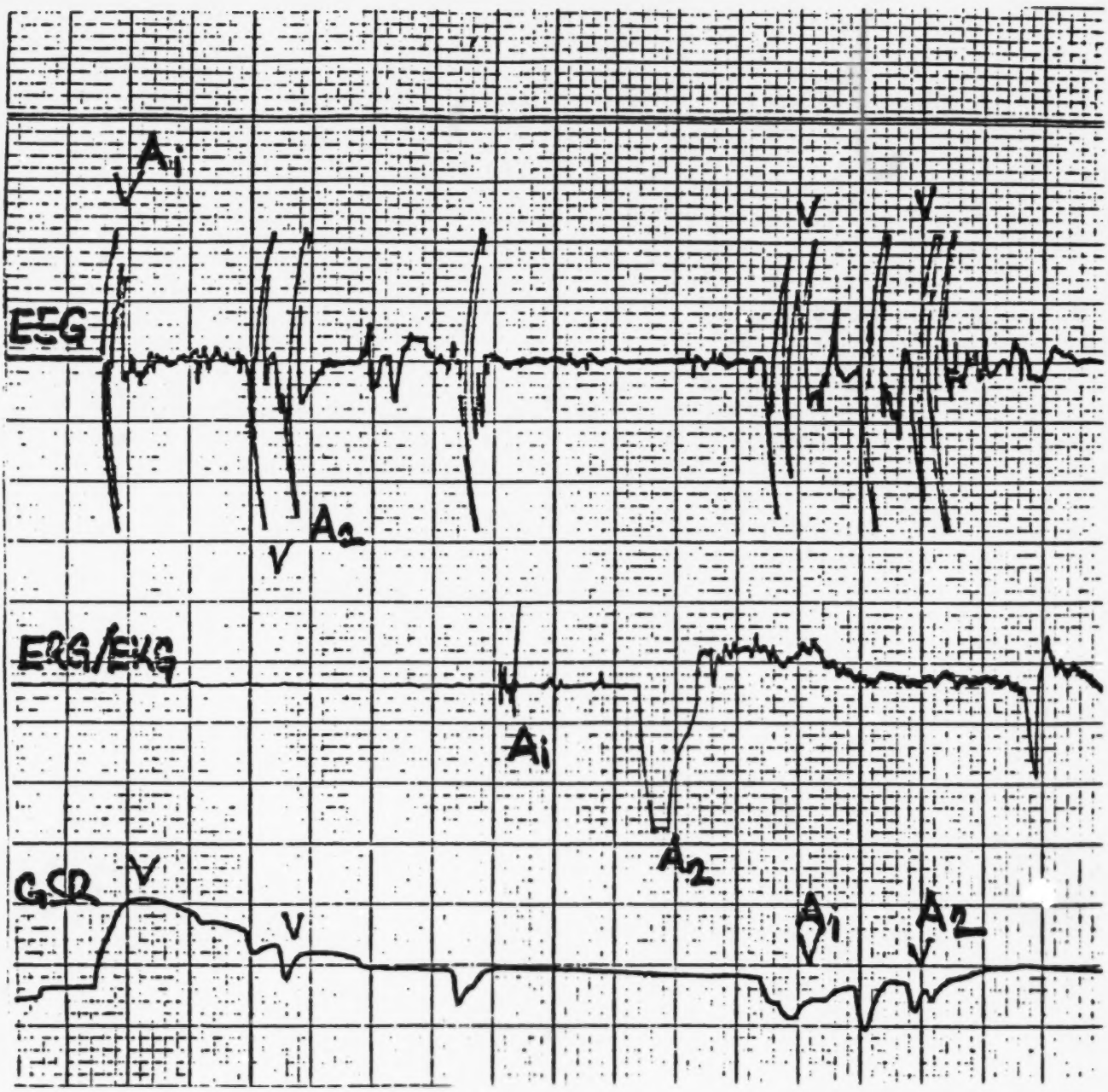
Example of a multichannel
Biometric recording



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